

## 4.0 COMMAND AND TELEMETRY DATA BASE FORMAT

The CTDB tape shall be organized into multiple files as specified by the remainder of this section.

Logical records within each CTDB file shall be in 141 byte card image format, ASCII encoded. Logical records within each PDB output tape file shall be in 80 byte card image format, ASCII encoded.

Each record shall contain a unique two character record type in bytes 134-135. This record type identifies the format/contents of the remainder of the logical record.

File types and extensions will be as specified on the following page where % = letter code of the subsystem for TINF, TCAL, and CMDD files and where % = format identification for TCON files.

When transporting CTDB by tape, a single End of File (EOF) shall separate files on the tape(s). Two consecutive EOFs shall indicate end of reel. Three consecutive EOFs shall indicate end of information. A single file shall not span tape reel boundaries.

The tape shall be blocked 50 logical records per physical tape record. If required to maintain the blocking factor, the last physical record of each file shall be padded with ASCII blank fill characters.

### 4.1 COMMAND AND TELEMETRY DATA BASE FILE CONTENT

The first file on the CTDB tape(s) shall be the Command Telemetry Tape Content (CTTC) file.

The first record shall be an ZN record (Section 5.2 ZN File Description Record) which identifies the file as the Command Telemetry Tape Contents file.

The files on the tape shall consist of one or more record types. Table 4-1 specifies the legal record types which may be contained in each file type, with a given file type appearing more than once in the PDB as indicated.

Unless noted otherwise each record and each data item within a record must be provided for each file type supplied via the PDB tape.

Throughout this document the terms alphanumeric and character string are used interchangeably. Each is intended to identify a string composed from the character set of all letters (A to Z), digits 0 to 9 and the following special characters:

- a. - (for commands and calibrations only).
- b. + (for commands and calibrations only).
- c. All characters found on typewriter/computer keyboard valid for calibration English only.

A mnemonic may contain any of these characters. However, it must begin with an upper case alphabetic character. Throughout the PDB tape field definitions, all left and right justified fields are appropriately padded with blanks unless otherwise specified.

Table 4-1 File Types

DESCRIPTION	FILE TYPE	MORE THAN 1 ALLOWED	LEGAL RECORD TYPES
Command Telemetry Tape Content File	CTTC.DAT	NO	ZN, GC
Telemetry Format Configuration File	TCON.%	YES	ZN, ZM, ZL, ZX, Z@, ZZ, ZS, ZR, ZD, Z!
Telemetry Information File	TINF.%	YES	ZN, ZI
Telemetry Calibration File	TCAL.%	YES	ZN, ZA, ZB, ZE, ZV, ZU, ZY, ZJ, ZP, ZQ, ZO, ZT, ZC, ZH, ZG
Command File	CMDD.%	YES	ZN, ZK, ZF, ZG

## 5.0 TELEMETRY FORMAT CONFIGURATION FILE

### 5.1 BACKGROUND INFORMATION

Section 5 describes the overall structure of each telemetry format. One TCON.% file should exist for each Support Systems Module (SSM) downlink format. For each SSM format, the Science Instruments Control and Data Handling System (SI C&DH) may be in fixed or normal mode. For example, the TCON.A file will contain the information for formats AF and AN. Therefore, if a new format is defined, a new TCON.% file will be defined with its associated records. Generally, it is expected that if a new format is defined, it will closely resemble an existing format and the new file can be copied and edited from an existing file. An existing file is anywhere from just 10 to around 250 records (one for AF and AN, etc.). There are 9 types of records that are valid in this file.

- a. A ZN record to describe the particular file.
- b. A ZM record to describe the overall characteristics of the format, such as;
  - (1) Format Identifier - (T, A, F, P, X, Y, Z, C, D, E, S, M, U, N).
  - (2) Bit rate of the format - (32.0, 4.0, 0.5).
  - (3) Bits per word - (8).
  - (4) Maximum subframe depth - (20, 120, 1200).
  - (5) Whether it is a programmable format or not and whether a MUX file should be generated.
- c. A ZL record to describe the cross-reference measurement IDs for the sync pattern, format ID, SSM minor frame counter, NASA Standard Spacecraft Computer #1 (NSSC-I) minor frame counter and their associated telemetry locations.
- d. A ZX record to describe the Data Interface Units (DIU) and DIU addresses that are submultiplexed.
- e. A Z@ record to describe allowable duplicate data addresses and their associated monitors.
- f. A ZZ record to describe the SSM Flight Software telemetry subcom group numbers and depths.
- g. A ZS record to describe the subframe positions, widths and depths.
- h. A ZR record to describe available plug & pin numbers.
- i. A ZD record to describe the sample rate extra delay peculiar to a subsystem.
- j. A Z! record to end the file.

All record types are described in an 141 column card image format divided into fields in Tables 5-6 to 5-26. Provided along with field numbers are starting and ending columns of the field contents. For all types of records, columns 134 and 135 carry the record identifier as defined in Table 5-1. This record type identifies the format and content of the remainder of the logical

record. The starting and ending record bytes for each field may or may not change, although it is not anticipated that the format of the TCON.% will change. These changes, if any, depend upon revision of this document and modification of the SATS software.

It is important to note here that the TCON.% files, the TINF.% files and the TCAL.% files are raw inputs and do not necessarily contain all information necessary to fully define a format or calculation. As raw inputs, they are subject to modification and addition by the ground database processing software to add certain information to fully define each format. The information that is added to gain traceability to the Engineering Data Base as far as the file are concerned is limited to SSM subframe definitions. As the ground database processing software assigns telemetry locations to monitors it creates subframes as necessary to accommodate those monitors. As far as the TINF.% file are concerned, the information that is added is telemetry location to those monitors whose telemetry location field was blank. See the description of the ZI record in section 6 for a complete description of telemetry location (downlink format data position) and the function of auto assign in the ground database processing software. Table 5-1 Record Types provides a cross-reference for each of the record types. Each record type is defined by its own figure and table.

Table 5-1. Record Types

Refer to Table Number	Record Name	Purpose	Record ID
5-6	File Description.	To describe the file content.	ZN
5-8	Format Description.	To describe the TLM format.	ZM
5-10	Special Monitors Definitions		ZL
5-12	Submultiplexed Data.	To describe DIU addresses that contain submultiplexed data in a specific format.	ZX
5-14	Duplicate Address Data.	To define duplicate addresses and associated measurement numbers that are allowed.	Z@
5-14	Subcom Group Data.	To define subcom groups within which SSM software telemetry appears.	ZZ
5-18	Subframe Definitions	To specify which minor frame locations have subframes and their corresponding width and depth.	ZS
5-20	Available plug & DIU numbers.	Self explanatory	ZR
5-22	Time Delay Data		ZD
5-24	End of Configuration Data		Z!

#### 5.1.1 Format

Format refers to the organization or "structure" of the telemetry pattern in terms of minor frame length and the number and sizes of the subframes. Formats may be fixed or programmable. Programmable formats are those which can be uplinked by command to change the structure or data content in flight.

The fixed formats D, E, and the Scientific Instrument (SI) and SI C&DH portion of programmable formats are hardwired Read Only Memory (ROM) formats while the SI C&DH is in fixed mode, and their structure can be changed in flight only through instrument/Orbital Replacement Unit (ORU) changeout or modification.

#### 5.1.2 Frame Definitions

The three types of telemetry frames used in this document are defined below:

- a. Minor frame.
- b. Major frame.
- c. Subframe.

5.1.2.1 Minor Frame. The minor frame is the data contained between the start of one 24-bit telemetry sync word and the next.

5.1.2.2 Major Frame. The major frame is the period in which all data in the format is sampled at least once. (The two exceptions to this are the High Resolution Spectrograph (HRS) threshold monitors, where six major frames are needed to complete the data, and Wide Field/Planetary Camera (WF/PC) memory dump where 64 major frames are needed to complete the dump.). Each format has a fixed number of minor frames in each major frame.

5.1.2.3 Subframe. A subframe is a group, or list, of measurements that are sampled sequentially, one per minor frame, until each measurement in the group has been sampled once. The list is then repeated. The length of the longest subframe determines how many minor frames are required for the major frame. Each subframe is assigned to a specific minor frame word location. As a result, the measurements in the subframe will appear in that word location, one after the other, in a fixed sequence.

#### 5.1.3 Kilobits per Second Programmable Formats

5.1.3.1 Format Size. The size of the 4 kbps programmable format is 250 x 120.

5.1.3.2 Format Assignments. Since the minor frame has 2000 bits ( $250 \times 8 = 2000$ ), it will be scanned twice a second at the 4 kbps rate, so a measurement on each minor frame will be sampled twice a second, or 2.0 sps.

### 5.1.3.3 Sample Rates

Sample rates on subframes depend on the length of the subframe. For example, a 20-word subframe will be sampled at 2 words per second and 10 seconds will be needed to read all 20 words. Therefore, the sample rate for words on this subframe will be one per 10 seconds, or .1 sps. The other rates for subframes in this format at 4 kbps are defined in Table 5-2: Subframe Sample Rates 4 kbps Programmable.

Table 5-2. Subframe Sample Rates 4 kbps Programmable

Words in Subframe	Sample Rate	Auto-Assign Legal
2	1.0	YES
3	.67	YES
4	.5	YES
5	.4	YES
6	.33	YES
8	.25	YES
15	.133	YES
20	.1	YES
24	.083	NO
30	.067	NO
40	.05	NO
60	.033	YES
120	.017	YES

### 5.1.4 32 Kilobits per Second Programmable Formats

5.1.4.1 Format Size. The format size of 32 kbps programmable formats is 200 x 1200.

5.1.4.2 Format Assignments. Since the minor frame has 1600 bits ( $200 \times 8 = 1600$ ), it will be scanned 20 times a second at the 32 kbps rate, so a measurement on each minor frame will be sampled 20 times a second, or 20.0 sps.

5.1.4.3 Sample Rates. Sample rates on subframes depend on the length of the subframe. For example, a 20-word subframe will be sampled at the rate of 20 words per second, so all 20 words will be read in 1 second. Therefore, the sample rate for these words will 1.0 sps. The other rates for subframes in this format are defined in Table 5-3 Subframe Sample Rates 32 kbps Programmable.

Table 5-3. Subframe Sample Rates 32 kbps Programmable

Words in Subframes	Sample Rate	Auto Assign Legal
2	10	YES
3	6.67	YES
4	5.0	YES
5	4.0	YES
6	3.33	YES
8	2.5	YES
10	2.0	YES
12	1.67	NO
15	1.33	YES
20	1.0	YES
24	.83	NO
30	.67	NO
40	.5	NO
60	.33	YES
80	.25	NO
120	.167	YES
600	.033	NO
1200	.017	NO

#### 5.1.5 500 Bits per Second Programmable Formats

5.1.5.1 Format Size. The format size for 500 bps programmable formats is 125 x 20.

5.1.5.2 Format Assignments. Since the minor frame has 1000 bits ( $125 \times 8 = 1000$ ), it will take two seconds to scan the frame once at 500 bps, so a measurement on each minor frame will be sampled 1 per 2 seconds, or 0.5 sps.

5.1.5.3 Sample Rates. At the rate of 500 bps, a 20-word subframe will take 40 seconds for a complete readout, which is 1 sample per 40 seconds, or .025 SPS. The other rates for subframes in this format at 500 bps are defined in Table 5-4 Subframe Sample Rates 500 bps Programmable.

Table 5-4. Subframe Sample Rates 500 bps Programmable

Words in Subframe	Sample Rate	Auto Assign Legal
2	.25	YES
4	.125	YES
5	.1	YES
10	.05	YES
20	.025	YES

#### 5.1.6 Kilobits per Second and 500 Bits per Second Fixed Formats

5.1.6.1 Format Size. The format size for the fixed formats is 125 x 20.

5.1.6.2 Format Assignments. Since the minor frame has 1000 bits ( $125 \times 8 = 1000$ ), it will be scanned four times a second at the 4 kbps rate and one every 2 seconds of the 500 bps rate. The sample rates of the 500 bps rate will always be eight times slower than the rates in the 4k. The data content of E at 500 bps is identical to D at 4 kbps.

5.1.6.3 Sample Rates. Sample rates for both the fast and slow rate are summarized below:

<u>Words in Subframe</u>	<u>4 kbps Sample Rate</u>	<u>500 bps Sample Rate</u>
2	2.0	.250
4	1.0	.125
5	.8	.1
10	.2	.05
20	.4	.025

## 5.2 ZN RECORD TYPE - FILE DESCRIPTION RECORD

The ZN record describes the file content. It must be the first record contained in each file. Only one ZN record is legal per file. Refer to Tables 5-5 and 5-6.

Table 5-5. ZN Record Type

DESCRIPTION	RECORD BYTE	FIELD #	FIELD USE
File Number	1-4	1	B
File Type	5-8	2	B
Number of Records	9-14	3	B
Creation Date	15-20	4	B
Subsystem Letter Code	21	5	B
Filed Descriptive Text	22-45	6	B
Name of Contact	46-61	7	B
Telephone Number	62-71	8	B
Additional Comments	72-133	9	B
Record Type (ZN)	134-135	71	B
Record Number	136-141	72	B

### FIELD USE KEY

- |                           |  |
|---------------------------|--|
| A Required for PDB & SATS | D Entry required by SATS error checking, entry value is "don't care" for PDB |
| B Required for PDB only   | E Required for SDM-1001, SDM-1002, SDM-1014 document only                    |
| C Required for SATS only  | F Information  |
|                           | G Not required   |

Table 5-6. ZN File Description

<u>FIELD #</u>	<u>RECORD BYTE</u>	<u>FIELD DESCRIPTION AND FORMAT</u>
1	1-4	File number of the file which the ZN record is describing. Four numeric digits with leading zeros.
2	5-8	File Type. Four alphabetic characters which designate type of file.
3	9-14	Number of records contained in this file including ZN record. Six numeric digits with leading zeros.
4	15-20	Creation date in the form MMDDYY. Six numeric digits with leading zeros per subfield as needed.
5	21	Subsystem letter code
6	22-45	Textual description of file content.
7	46-61	Name of responsible individual for this file.
8	62-71	Telephone number; area code plus seven digits.
9	72-133	Additional comments.
71	134-135	ZN record type.
72	136-141	Record number with leading zeros.

### 5.3 ZM RECORD TYPE - FORMAT DESCRIPTION RECORDS

The ZM record describes the basic structure of the particular format. This information includes major frame size, minor frame length and subframe depth. Refer to Tables 5-7 and 5-8.

Table 5-7. ZM Record Type

DESCRIPTION	RECORD BYTE	FIELD #	FIELD USE
Record ID "CM"required	1-2	1	A
Blank	3	2	
Vehicle Format "V" required	4	3	A
Blank	5	4	
Format Identifier (One character A, X, Y, etc.)	6	5	A
Blank	7	6	
Reverse Telemetry (Normally Blank)	8-9	7	g
Blank	10	8	
Minor Frame Length In Bytes (Normally 125,200 or 250)	11-14	9	A
Blank	15	10	
Bitrate in Kbps (0.5, 4.0, 32.0)	16-22	11	A
Blank	23	12	
Dump Mode Character (Normally Blank)	24	13	G
Blank	25	14	
Syllable Size in Bits (Should be 8)	26-27	15	A
Longest Subframe any positive integer (required)	28-32	16	A
Blank	33-35	17	
Mux or Nomux Files	36-40	18	A
Blank	41-44	19	
Normal NSSC-I format	45-50	20	A
Blank	51-53	21	
SDF format	54-56	22	G
Blank	57-59	23	
No instrumentation records	60-64	24	C
Blank	65-67	25	
NOX (blank) Multiplex S/W subcom monitors or 'NOX'	68-70	26	A
Blank	71-132	27	
Blank	133	70	B
Record ID (ZM)	134-135	71	B
Record Number	136-141	72	B

#### FIELD USE KEY

- |                           |  |
|---------------------------|--|
| A Required for PDB & SATS | D Entry required by SATS error checking, entry value is "don't care" for PDB |
| B Required for PDB only   | E Required for SDM-1001, SDM-1002, SDM-1014 document only                    |
| C Required for SATS only  | F Information  |
|                           | G Not required   |

Table 5-8 ZM Format Description

<u>FIELD #</u>	<u>RECORD BYTE</u>	<u>PARAMETER</u>	<u>DESCRIPTION</u>
1	1-2	Record ID	Characters“CM” (required).
2	3-3	Blank	
3	4-4	Vehicle Format	Character “V” (required).
4	5-5	Blank	
5	6-6	Format Identifier	One Character Identified For The Format. Currently only T,A,F,P,X,Y, Z,C,D,E,S,M,U,N, are identified.
6	7-7	Blank	
7	8-9	Reverse Telemetry	Character “*R” For Reverse Telemetry or Blank (optional) Normally Blank.
8	10-10	Blank	
9	11-14	Minor Frame Length in Bytes	Positive Integer Value (Range 1 - 999) (required). Normally 125, 200, or 250. (Typewritten values of 0.5, 4.0, or 32.0 will be used.)
10	15-15	Blank	
11	16-22	Bitrate in KBPS	Positive Real (Floating Value, $0.0 < \text{RANGE} \leq 10000.0$ ) (required).
12	23-23	Blank	
13	24-24	Dump Mode Characters	Character“D” For Dump Mode or Blank (optional). Normally blank.
14	25-25	Blank	
15	26-27	Syllable Size in BITS	Any Positive Integer $< 100$ (currently Hardwired to 8); should be 8.
16	28-32	Longest Subframe	Any Positive Integer (required; usually 20, 120 or 1200) from 1 to 1200.
17	33-35	Blank	

Table 5-8. ZM Format Description (continued)

<u>FIELD #</u>	<u>RECORD BYTE</u>	<u>PARAMETER</u>	<u>DESCRIPTION</u>
18	36-40	Mux or Nomux Files	Characters "NOMUX" for no MUX File or blank (optional). Blank for programmable format.
19	41-44	Blank	
20	45-50	Normal NSSC-I format	Character "NORMAL" for SI normal subformat or blank (optional). Blank if NSSC-I operates only in fixed mode in this format.
21	51-53	Blank	
22	54-56	SDF format	Character "SDF" for scientific data format or blank (optional). Normally blank.
23	57-59	Blank	
24	60-64	No instrumentation records	Characters "NOII" if no instrumentation records or blank (optional). Normally blank.
25	65-67	Blank	
26	68-70	NOX	Multiplex S/W subcom monitors or 'NOX' - no multiplex.
27	71-132	Blank	
70	133	Blank	
71	134-135	Record ID	Record identifier (required).
72	136-141	Record Number	Record Number (required).

#### 5.4 ZL RECORD TYPE - SPECIAL MONITORS DEFINITION RECORDS

The ZL records describe important data for Special Monitors for special handling within the format. Some of the Special Monitors are Sync Word, Format ID, Minor Frame Counter, NSSC-I format and Vehicle Time Word. ZL records must precede ZS records for proper error checking. Refer to Tables 5-9 and 5-10.

Table 5-9. ZL Record Type Special Monitors Definition

DESCRIPTION	RECORD BYTE	FIELD #	FIELD USE
Record ID "CI"	1-2	1	A
Blank	3	2	
Format Identifier	4	3	A
Blank	5-6	4	
Cross-Reference Measurement Number	7-14	5	A
Special Monitor Type	15-17	6	A
Blank	18-19	7	
Minor Frame Word Assignment	20-29	8	A
Blank	30-32	9	
Sync Pattern or Format ID	33-43	10	A
Blank	44-132	11	
Blank	133	70	B
Record ID "ZL"	134-135	71	B
Record Number (Required)	136-141	72	

#### FIELD USE KEY

- |                           |  |
|---------------------------|--|
| A Required for PDB & SATS | D Entry required by SATS error checking, entry value is "don't care" for PDB |
| B Required for PDB only   | E Required for SDM-1001, SDM-1002, SDM-1014 document only                    |
| C Required for SATS only  | F Information  |
|                           | G Not required   |

Table 5-10. ZL Record Type

<u>FIELD #</u>	<u>RECORD BYTE</u>	<u>PARAMETER</u>	<u>DESCRIPTION</u>
1	1-2	Record ID (A)	Characters "CI".
2	3-3	Blank	
3	4-4	Format Identifier (B)	Must be the same as format ID on the "ZM" record.
4	5-6	Blank	
5	7-14	Cross-Reference Measurement No. (C)	See section 6.0 for valid cross-reference measurement ID.
6	15-17	Special monitor type (D)	Character "/" followed by two character code description. Valid codes are: SY for sync pattern MF for minor frame counter (SSM) FI for format ID VT for vehicle time NF for normal/fixed mode (C&DH)
7	18-19	Blank	
8	20-29	Minor frame word assignment (E)	If the special monitor type in field 6 is SY, MF, FI or VT, then this assignment is a minor frame word location of the format X, XX, X-X, X-XX, or XX-XX (see Example 1 in Section 6.5). If the special monitor type in field 6 is NF, then this assignment is a minor frame, subframe, and bit location of the format identical to Example 3 in Section 6.1.4.
9	30-32	Blank	
10	33-43	Sync pattern or format ID (F)	For sync pattern 6 hex numbers, for format ID 2 hex numbers.
11	44-132	Blank	
70	133	Blank	
71	134-135	Record ID (G)	"ZL".
72	136-141	Record Number	Record Number Required.

Table 5-10. ZL Record Type (continued)

Example:

Columns =	1	4	7	20	33	134:135
	CI	A	D19J700G/SY	1-3	FAF320	ZL
	CI	A	D19Q400A/MF	5		ZL
	CI	A	D19J401A/FI	4	8A	ZL
	CI	A	D19W4020A/VT	13-14	Not used normally	ZL
	CI	A	M04X039B/NF	85/1:8		ZL
	^	^	^	^	^	^
Parameters =	A	B	C	D	E	G

## 5.5 ZX RECORD TYPE - SUBMUXED DATA INTERFACE UNIT CHANNELS DEFINITION ZX RECORDS

The ZX records describe the Submultiplexed DIU Channels available on this format. Refer to Tables 5-11 and 5-12.

Table 5-11. ZX Record Type

DESCRIPTION	RECORD BYTE	FIELD #	FIELD USE
Record Identifier "CX"	1-2	1	A
Blank	3	2	
Format Identifier (T,A,F,P,X,Y,Z,C,D,E,S,M,N,U)	4	3	A
Blank	5-7	4	
DIU Number	8	5	A
Blank	9	6	
DIU Channel (Octal)/Depth of Submux (Number of multiplexes in decimal)	10-132	7	A
Blank	133	70	B
Record ID "ZX"	134-135	71	B
Record Number (Required)	136-141	72	B

### FIELD USE KEY

- |                           |  |
|---------------------------|--|
| A Required for PDB & SATS | D Entry required by SATS error checking, entry value is "don't care" for PDB |
| B Required for PDB only   | E Required for SDM-1001, SDM-1002, SDM-1014 document only                    |
| C Required for SATS only  | F Information  |
|                           | G Not required   |

Table 5-12. ZX Record Type-Description

<u>FIELD #</u>	<u>RECORD BYTE</u>	<u>PARAMETER</u>	<u>DESCRIPTION</u>
1	1-2	Record Identifier (A)	Characters "CX".
2	3-3	Blank	
3	4-4	Format Identifier (B)	Must be the same as format ID on "CM" record.
4	5-7	Blank	
5	8-8	DIU number (C)	Any positive integer from 1 to 6.
6	9-9	Blank	
7	10-132	DIU channel (octal)/depth of submux (number of multiplexes in decimal) (D/E)	Any positive octal integer followed by the character "/" followed by another positive decimal integer followed by a comma if another entry is needed (at least one entry is necessary).
70	133-133	Blank	
71	134-135	Record ID (F)	"ZX".
72	136-141	Record Number	Record Number (Required).

Example:

Columns =	1	4	8	10	134:135
	CX	A	5	361/4, 373/30, 376/24	ZX
	CX	A	4	360/6, 363/30, 366/24	ZX
	^	^	^	^	^
Parameters =	A	B	C	D/E	F

## 5.6 Z@ RECORD TYPE - DUPLICATE ADDRESS DATA

The Z@ records describe data addresses (DIU or software) that may be duplicated by more than one monitor. Refer to Tables 5-13 through 5-16.

Table 5-13. Z@ Record Type

DESCRIPTION	RECORD BYTE	FIELD #	FIELD USE
Record Identifier "CQ"	1-2	1	A
Blank	3	2	
Delimiter ";" (semicolon)	4	3	A
Blank	5	4	
DIU Address or Software Address	6-15	5	A
Blank	16	6	
Delimiter ";" (semicolon)	17	7	A
Blank	18	8	
First Set of Cross-Reference Measurement IDs	VARIES	9	A
Delimiter	VARIES	10	A
Second Set of Cross-Reference Measurement IDs	VARIES	11	A
Continuation Flag	133	70	B
Record Type "Z@"	134-135	71	B
Record Number	136-141	72	B

### FIELD USE KEY

- |                           |  |
|---------------------------|--|
| A Required for PDB & SATS | D Entry required by SATS error checking, entry value is "don't care" for PDB |
| B Required for PDB only   | E Required for SDM-1001, SDM-1002, SDM-1014 document only                    |
| C Required for SATS only  | F Information  |
|                           | G Not required   |

Table 5-14. Z@ Record Type-Description

<u>FIELD #</u>	<u>RECORD BYTE</u>	<u>PARAMETER</u>	<u>DESCRIPTION</u>
1	1-2	SATS Record ID	Characters "CQ"
2	3-3	Blank	
3	4-4	Delimiter	";" (semicolon)
4	5-5	Blank	
5	6-15	Data Address	The data address is the hardware DIU address or software symbolic data address that is allowed to have more than one measurement number assigned to a bit or range of bits for that address (see further description below). Also refer to ICD-26, Pt 4 Section 6.11.
6	16	Blank	
7	17	Delmiter	";" (semicolon)
8	18	Blank	
9	Starts at 19	First Set of Cross-Reference Measurements IDs	The measurement or list of measurements delimited within the field by commas (,), in the short form of the cross-reference measurement ID (1st character and 5th, 6th, and 7th characters). Refer to ICD-26, Pt 4 Section 6.2. This measurement (or list of measurements) is the one that occupies the bit or bits that are also occupied by the measurement (or list of measurements) in the field labelled Second Set of Cross-Reference Measurement IDs.
10	VARIES	Delimiter	
11	VARIES	Second Set of Cross-Reference Measurement IDs	The measurement (or list of measurements) that occupy the same bit or range of bits that the measurement(s) in Field 9 occupy.

Table 5-14. Z@ Record Type-Description (continued)

70	133	Continuation Flag	Non-blank if Fields 9, 10, and/or 11 are incomplete in the space allowed in this record (bytes 19-132).
71	134-135	Record ID	"Z@"
72	136-141	Record Number	Record Number (required).

Example of Z@ Records:

CQ ; 5350 ; B013,B011	;I013,I011	Z@00110
CQ ; DVRSA+1 ; B105,B106,B107,B108,B302,	; I105,I106,I107,I108,I302	Z@00120

The continuation record for the data addresses that may be duplicated by more than one monitor.

Table 5-15. Z@ Record Type Duplicate Address Continuation Record

DESCRIPTION	RECORD BYTE	FIELD #	FIELD USE
Continuation of previous incomplete fields (9, 10, 11).	1-132	1	A
Continuation Flag	133	70	B
Record Type "Z@"	134-135	71	B
Record Number	136-141	72	B

FIELD USE KEY

- |                           |  |
|---------------------------|--|
| A Required for PDB & SATS | D Entry required by SATS error checking, entry value is "don't care" for PDB |
| B Required for PDB only   | E Required for SDM-1001, SDM-1002, SDM-1014 document only                    |
| C Required for SATS only  | F Information  |
|                           | G Not required   |

Table 5-16 Z@ Record Type Duplicate Address Continuation Record-Description

<u>FIELD #</u>	<u>RECORD BYTE</u>	<u>PARAMETER</u>	<u>DESCRIPTION</u>
1	1-132	Delimited Cross-Reference Measurement Number List(s)	The continuation of previous record incomplete field(s) (9, 10, 11).

The duplicate address record was a result of a modification to the SATS software to allow for SA-2 instrumentation additions. For this record, the software does not actually look in specific record locations for data, but scans the record for appropriate delimiters. The occurrence of a delimiter indicates the end of a field or subfield. In this case, Field 1 is terminated by the appearance of the semicolon (Field 3). Field 5, the data address field, is terminated by the appearance of the second semicolon (Field 7). Spaces or blanks are ignored by the SATS software. Field 9 must contain at least one measurement ID, but not more than eight for hardware addresses and not more than twenty-four for software addresses. The measurements listed within Field 9 must be further delimited within the field by commas (.). Field 9 is terminated by the occurrence of the third semicolon (Field 10). Field 11 follows the same rule as Field 9. If the second space is fully subscribed prior to completion of the duplicate address definition, then a continuation record follows. In this case, the continuation field, Field 70, of the present record must be non-blank *and* a tilde (~) must appear as the last non-blank character in the range from bytes 19 to 132.

For the continuation record, if Field 9 (the first set of cross reference ID's) of the previous record was incomplete, its data continues in bytes 1 to 132 as necessary to complete its definitions. Then the semicolon delineates the data from Field 11 (the second set of cross reference ID's) of the previous record.

If one continuation record is insufficient to complete the definition, then Field 70 of the continuation record will be non-blank *and* the tilde (~) must appear as the last non-blank character in the range of bytes from 1 to 132.

## 5.7 ZZ RECORD TYPE - MULTIPLEX S/W SUBCOM DEFINITION RECORD

The ZZ record defines the flight software subcom groups and has the data address for that subcom group. Refer to Tables 5-17 and 5-18.

Table 5-17. ZZ Record Type

DESCRIPTION	RECORD BYTE	FIELD #	FIELD USE
Record ID "CZ"	1-2	1	A
Blank	3	2	
Format Identifier	4	3	A
Blank	5-6	4	
Subcom Group Number	7-8	5	A
Blank	9	6	
Data Address	10-15	7	A
"/"	16	8	A
Subframe Depth	17-19	9	A
Blank	20-132	10	
Blank	133	70	B
Record ID (ZZ)	134-135	71	B
Record Number (Required)	136-141	72	B

### FIELD USE KEY

- |                           |  |
|---------------------------|--|
| A Required for PDB & SATS | D Entry required by SATS error checking, entry value is "don't care" for PDB |
| B Required for PDB only   | E Required for SDM-1001, SDM-1002, SDM-1014 document only                    |
| C Required for SATS only  | F Information  |
|                           | G Not required   |

Table 5-18. ZZ Record Type-Description

<u>FIELD #</u>	<u>RECORD BYTE</u>	<u>PARAMETER</u>	<u>DESCRIPTION</u>
1	1-2	Record Identifier (A)	Characters "CZ".
2	3-3	Blank	
3	4-4	Format Identifier (B)	Must be the same as format ID on "CM" record.
4	5-6	Blank	
5	7-8	Subcom group number (C)	Must be a dollar sign with HEX number 1 thru F
6	9-9	Blank	
7	10-15	Data address (D)	Subcom group data address. The last character of the address must match the last character of the subcom group number.
8	16-16	/	Slash delimiter.
9	17-19	Subframe Depth (E)	Subcom Depth. Legal values: 1, 2, 3, 4, 5, 6, 8, 10, 15, 20, 60, 120.
10	20-132	Blank	
70	133	Blank	
71	134-135	Record ID (F)	"ZZ".
72	136-141	Record Number	Record Number (Required).

Example:

Columns =	1	4	7	10	17	134:135
	CZ	A	\$1	SUBCM1	120	ZZ
	CZ	C	\$3	SUBCM3	120	ZZ
	CZ	P	\$5	SUBCM5	120	ZZ
	^	^	^	^	^	^
Parameters =	A	B	C	D	E	F

## 5.8 ZS RECORD TYPE - SUBFRAME DEFINITION RECORDS

The ZS records define those channels on the telemetry minor frame which are to be preassigned as subframes. A subframe must have a depth of at least two minor frames. Refer to Tables 5-19 and 5-20.

Table 5-19. ZS Record Type

DESCRIPTION	RECORD BYTE	FIELD #	FIELD USE
Record ID "CS"	1-2	1	A
Blank	3	2	
Format Identifier	4-5	3	A
Blank	6	4	
Subframe Location	7-10	5	A
Blank	11	6	
Subframe Width (1,2, or 3 Channels)	12	7	A
Blank	13	8	
Subframe Depth (In Minor Frames)	14-17	9	A
Blank	18-132	10	
Blank	133	70	B
Record ID (ZS)	134-135	71	B
Record Number (Required)	136-141	72	B

### FIELD USE KEY

- |                           |  |
|---------------------------|--|
| A Required for PDB & SATS | D Entry required by SATS error checking, entry value is "don't care" for PDB |
| B Required for PDB only   | E Required for SDM-1001, SDM-1002, SDM-1014 document only                    |
| C Required for SATS only  | F Information  |
|                           | G Not required   |

Table 5-20. ZS Record Type-Description

<u>FIELD #</u>	<u>RECORD BYTE</u>	<u>PARAMETER</u>	<u>DESCRIPTION</u>
1	1-2	Record Identifier (A)	Characters "CS".
2	3-3	Blank	
3	4-5	Format Identifier (B)	See Below.
4	6-6	Blank	
5	7-10	Subframe location (C)	Positive Integer (0 < Range < 10000).
6	11-11	Blank	
7	12-12	Subframe width (1,2, or 3 channels) (D)	Positive Integer (0 < Range < 10).
8	13-13	Blank	
9	14-17	Subframe Depth (E)	Positive Integer (0 < Range < 10000).
10	18-132	Blank	
70	133	Blank	
71	134-135	Record ID (F)	"ZS".
72	136-141	Record Number	Record Number (Required).

The first character of the format ID must be the same as the format ID character specified on the "ZM" record for a configuration record set, and the second character indicates the subframe type (SSM, SI fixed, or SI normal). The second character of the format ID can be blank, "F" or "N". If it is blank, it indicates a SSM subframe: if it is "F", it indicates a fixed SI C&DH subframe: and if it is "N", it indicates a normal SI C&DH subframe. These records only appear for preassigned subframes associated with preassigned monitors (i.e., preassigned telemetry locations).

Example:

Columns =	1	4	7	12	14	134:135
	CS	A	9	1	5	ZS
	CS	AF	130	1	120	ZS
	CS	AN	130	1	1200	ZS
	CS	A	21	2	10	ZS
	CS	A	23	3	2	ZS
	^	^	^	^	^	^
Parameters =	A	B	C	D	E	F

## 5.9 ZR RECORD TYPE - RECEPTACLE DEFINITION RECORD

The ZR record (optional) describes the available plug and pin receptacle numbers for this spacecraft (this record is not normally used). Refer to Tables 5-21 and 5-22.

Table 5-21. ZR Record Type

DESCRIPTION	RECORD BYTE	FIELD #	FIELD USE
Record ID (A)	1-2	1	C, G
Blank	3-3	2	
Subsystem subfield designator (B)	4-5	3	C, G
Blank	6-6	4	
Plug, receptacle, or connector descriptor (C)	7-7	5	C, G
Blank	8-8	6	
Receptacle number range (D)	9-13	7	C, G
Blank	14-14	8	
Pin number range (E)	15-20	9	C, G
Blank	21-132	10	
Blank	133	70	B
Record ID (F)	134-135	71	B
Record Number (Required)	136-141	72	B

FIELD USE KEY

- |                           |  |
|---------------------------|--|
| A Required for PDB & SATS | D Entry required by SATS error checking, entry value is "don't care" for PDB |
| B Required for PDB only   | E Required for SDM-1001, SDM-1002, SDM-1014 document only                    |
| C Required for SATS only  | F Information  |
|                           | G Not required   |

Table 5-22. ZR Record Type-Description

<u>FIELD #</u>	<u>RECORD BYTE</u>	<u>PARAMETER</u>	<u>DESCRIPTION</u>
1	1-2	Record ID (A)	Characters "CR".
2	3-3	Blank	
3	4-5	Subsystem subfield designator (B)	
4	6-6	Blank	
5	7-7	Plug, receptacle, or connector descriptor (C)	Positive Integer (0 < Range < 10).
6	8-8	Blank	
7	9-13	Receptacle number range (D)	Integer values N1-N2, N1 not greater than N2.
8	14-14	Blank	
9	15-20	Pin number range (E)	Integer values N1-N2, N1 not greater than N2.
10	21-132	Blank	
70	13	Blank	
71	134-135	Record ID (F)	"ZR".
72	136-141	Record Number	Record Number (Required).

Example:

Columns =	1	4	7	9	15	134:135
	CR	4D	J	1-18	1-100	ZR
	^	^	^	^	^	^
Parameters =	A	B	C	D	E	F

## 5.10 ZD RECORD TYPE - TIME DELAY (ZD) RECORD

The ZD record provides the system table with an extra delay in sample rate due to peculiarities in downlink and/or ground processing of telemetry. These results were used in Sunnyvale Hardware Software Interface Facility (HSIF) lab testing and are not necessary. Refer to Tables 5-23 and 5-24.

Table 5-23. ZD Record Type

DESCRIPTION	RECORD BYTE	FIELD #	FIELD USE
Record ID "CD"	1-2	1	C, D
Blank	3	2	
Format ID	4-5	3	C, D
Blank	6	4	
Subsystem (Letter Code)	7	5	C, D
Blank	8	6	
Delay	9-14	7	C, D
Blank	15-132	8	
Blank	133	70	B
Record ID (ZD)	134-135	71	B
Record Number (Required)	136-141	72	B

### FIELD USE KEY

- |                           |  |
|---------------------------|--|
| A Required for PDB & SATS | D Entry required by SATS error checking, entry value is "don't care" for PDB |
| B Required for PDB only   | E Required for SDM-1001, SDM-1002, SDM-1014 document only                    |
| C Required for SATS only  | F Information  |
|                           | G Not required   |

Table 5-24. ZD Record Type-Description

<u>FIELD #</u>	<u>RECORD BYTE</u>	<u>PARAMETER</u>	<u>DESCRIPTION</u>
1	1-2	Record ID (A)	Characters "CD".
2	3-3	Blank	
3	4-5	Format ID (B)	Same as a "ZS" record.
4	6-6	Blank	
5	7-7	Subsystems (C)	The letter codes correspond to subsystem monitors experiencing the delay. All subsystem letter codes are valid. If letter is an SI or C&DH code, field 3 character 2 must indicate whether it is a fixed or normal format.
6	8-8	Blank	
7	9-14	Delay (D)	Real value xxxx.x indicates additional seconds of sampling delay. This information is carried forward in systems table, not DEMUX table.
8	15-133	Blank	
70	133	Blank	
71	134-135	Record ID (E)	"ZD".
72	136-141	Record Number	Record Number (Required).

Example:

Columns =	1	4	7	9	134:135
	CD	T	B	1.0	ZD
	CD	TN	X	15.0	ZD
	^	^	^	^	^
Parameters =	A	B	C	D	E

## 5.11 Z! RECORD TYPE - END OF CONFIGURATION DATA RECORD

The Z! record signifies the end of the configuration data records for this particular format. Refer to Tables 5-25 and 5-26.

Table 5-25. Z! Record Type

DESCRIPTION	RECORD BYTE	FIELD #	FIELD USE
Record ID "C!"	1-2	1	A
Blank	3	2	
Format ID	4	3	A
Blank	5-6	4	
'End Of Configuration Data'	7-132	5	A
Blank	133	70	B
Record ID "Z!"	134-135	71	B
Record Number	136-141	72	B

### FIELD USE KEY

- |                           |  |
|---------------------------|--|
| A Required for PDB & SATS | D Entry required by SATS error checking, entry value is "don't care" for PDB |
| B Required for PDB only   | E Required for SDM-1001, SDM-1002, SDM-1014 document only                    |
| C Required for SATS only  | F Information  |
|                           | G Not required   |

Table 5-26. Z! Record Type-Description

<u>FIELD #</u>	<u>RECORD BYTE</u>	<u>PARAMETER</u>	<u>DESCRIPTION</u>
1	1-2	Record ID (A)	Characters "C!" Required.
2	3-3	Blank	
3	4-4	Format ID (B)	Should be the same as the format ID on "CM" record.
4	5-6	Blank	
5	7-132	'End of configuration data' (C)	Character string "end of configuration data" (not checked for by software).
70	133	Blank	
71	134-135	Record ID (D)	"Z!".
72	136-141	Record Number	

Example:

Columns =	1	4	7	134:135
	C!	A	End of configuration data	Z!
	^	^	^	^
Parameters =	A	B	C	D

## 6.0 TELEMETRY INFORMATION FILE

Section 6 describes the measurements contained in each telemetry format. One TINF.% should exist for each subsystem letter code in the spacecraft database, i.e. TINF.A, TINF.B, etc. There are 2 types of records (refer to Table 6-1) that are valid in this file.

- a. A ZN record to describe the particular file
- b. A ZI record to describe the telemetry measurement.

The ZN record is a 141 byte record as described in Section 5.2. The ZI record is a 141 byte record type described below.

As stated in Section 5, it is important to note here that the TCON.% files, the TINF.% files and the TCAL.% files are raw inputs and do not necessarily contain all information necessary to fully define a format, measurement, and/or calibrations. As raw inputs, they are subject to modification and addition by the SATS software to add certain information to fully define each format. The information that is added to gain traceability to the Engineering Data Base as far as the TINF.% file is concerned is limited to SSM HW monitors. Some of these monitors have the auto assign flag set, number of bits specified, and a telemetry location field. The SATS software assigns telemetry locations to these monitors and fills the subframes it created corresponding to the sample rates of the monitors.

The data in the TINF.% files is not the verbatim input to the SATS software, although it is similar in content. Prior to running through SATS software the TINF.% files are concatenated, reorganized, reformatted slightly, and the TCON.% files inserted in the proper location to provide the input to the SATS software.

The output of the SATS software is what is used as input to the Engineering Data Base Downlink Translation software.

Table 6-1 Record Types

Refer to Table	Record Name and Purpose	Record ID
5-6	File Description used to describe the file content.	ZN
6-3	Telemetry Information used to define measurement numbers and components, measurement range and accuracy data, data compression apertures, telemetry locations, sample rate, and data addresses.	ZI

## 6.1 ZI RECORD TYPE

The ZI record describes the information regarding an individual monitor in a particular format. Refer to Tables 6-2 through 6-5. Each monitor will have one or more records for each format in which the monitor appears. SSM and Optical Telescope Assembly (OTA)/Fine Guidance Subsystem (FGS) monitors will have one record (and any continuations, if necessary) for AF and AN, if the monitors is in format A, etc. SI and SIC&DH monitor will have one record (and any continuation, if necessary) for format AF, and one second (w/continuation as necessary) for format AN if the monitor is in format AN. This scheme is used for each format, P, F, X, Y, Z, A, T, and C. Since C only has CF, only one record (w/continuation as necessary) will appear.

Table 6-2. ZI Record Type

Description	Record Byte	Field #	Field Use
Blank	1-3	1	
Cross Reference Measurement ID	4-11	2	A
Blank	12	3	
Measurement description	13-32	4	A
Blank	33	5	
Format	34-35	6	A
Blank	36	7	
Telemetry Channel Field	37-51	8	A
Blank	52	9	
Sample Rate	53-56	10	A
Blank	57	11	
Measurement Range	58-74	12	F
Blank	75	13	
Measurement Accuracy	76-84	14	F
Signal Type	85	15	B
Blank	86	16	
Component	87-93	17	F
Blank	94	18	
Measurement ID	95-102	19	A
Blank	103	20	
Data Address	104-127	21	A
Blank	128	22	
Aperture	129-132	23	C
Blank	133	70	B
Record ID "ZI"	134-135	71	B
Record Number	136-141	72	B

### FIELD USE KEY

- |                           |  |
|---------------------------|--|
| A Required for PDB & SATS | D Entry required by SATS error checking, entry value is "don't care" for PDB |
| B Required for PDB only   | E Required for SDM-1001, SDM-1002, SDM-1014 document only                    |
| C Required for SATS only  | F Information  |
|                           | G Not required   |

Table 6-3. Flight Telemetry Instrumentation Records (ZI)

There are fifteen fields for each ZI record:

(A)	Cross Reference Measurement ID	Bytes	4-11	(required)
(B)	Measurement Description Field	Bytes	13-32	(required)
(C)	Format Field	Bytes	34-35	(required)
(D)	Telemetry Channel Field	Bytes	37-51	(required)
(E)	Sample Rate Field	Bytes	53-56	(required)
(F)	Measurement Range Field	Bytes	58-74	(optional)
(G)	Measurement Accuracy Field	Bytes	76-85	(optional)
(H)	Signal Type	Byte	85	(required)
(I)	Component Field	Bytes	87-93	(optional)
(J)	Measurement ID	Bytes	95-102	(required)
(K)	Data Address Field	Bytes	104-127	(required)
(L)	Aperture Field	Bytes	129-132	(required)
(M)	Blank	Bytes	133-133	(optional)
(N)	Record ID	Bytes	134-135	(required)
(O)	Record Number	Bytes	136-141	(required)

The record will be 141 characters in length. With the exception of the Aperture Field (K), all fields are left justified. An example of an instrumentation record and detailed description of each field in the record follows. The letter parameter indicated in parentheses in the description corresponds to the letter which points to the field in the example.

Occasionally a "!" will show up in byte 3 of the ZI records. This character indicates that the same part of the record has changed since the last release of SDM-1002 (DM-02). It is a change flag. It is removed during preprocessing of the file to prepare it for running through SATS.

Example:

4	13	34	37	53	58	76	85	87
C36X141B	OTA PRI BUS 1	TF	42/1:2-6	1.67	On/Off	1 count		11/TLM
A	B	C	D	E	F	G	H	I

95	104	129- 132	13 3	134- 135	136-141
COTPBUS1	5345:4	S1		ZI	000010
J	K	L	M	N	O

Table 6-4. ZI Record Type Continuation

DESCRIPTION	RECORD BYTE	FIELD #	FIELD USE
Blank	1-36	1	
Telemetry Channel (Continued from Previous Record)	37-51	2	A
Blank	52-132	3	
Blank	133	70	B
Record ID (ZI)	134-135	71	B
Record Number	136-141	72	B

FIELD USE KEY

- |                           |  |
|---------------------------|--|
| A Required for PDB & SATS | D Entry required by SATS error checking, entry value is "don't care" for PDB |
| B Required for PDB only   | E Required for SDM-1001, SDM-1002, SDM-1014 document only                    |
| C Required for SATS only  | F Information  |
|                           | G Not required   |

Table 6-5. Telemetry Information (ZI) Part II  
Optional Continuation Record For ZI Record Type

The ZI continuation Records are continuation records for the Telemetry Location Field. These continuation records provide the medium for describing long telemetry location inputs. They can only occur after a "ZI" record which has an underscore (\_) as the last non-blank character in the Telemetry Channel Field. The first thirty-six characters in the record are blanks (this places it directly below the preceding input records Telemetry Channel), followed by the maximum of fifteen characters which complete the field's description. If another continuation record is needed after a continuation record, the current continuation record must also have an underscore (\_) as its last non-blank character. The final continuation record does not need and should not have an underscore as its last non-blank character. There is no limit on the number of Continuation Records that can follow an Instrumentation Record. However, there can be no interruption of continuation records until after the last has been completed, or an error will result.

Examples:	1:36	37	134:135	136:141
		+34/3+34/4+34/_	ZI	00020
		5,34/6+34/7+34_	ZI	00030
		/8+34/9	ZI	00040

## 6.2 CROSS REFERENCE MEASUREMENT ID

Each measurement has an eight-character cross-reference measurement number to uniquely identify it. The eight characters form the five fields described below:

1. Field 1: The first character is a letter code for the subsystem or major element.
2. Field 2: The second and third characters are two numbers that identify the subsystem or element component. They range from 00 to 99.
3. Field 3: The fourth character is a letter code for the measurement parameter; i.e., voltage, current, temperature, etc.
4. Field 4: The fifth, sixth, and seventh characters are three numbers that range sequentially from 000 to 999 to uniquely identify each measurement within the subsystem or major element. As a result, a measurement can and must be uniquely identified from the subsystem letter code and number in field 4.
5. Field 5: The eighth character is a letter code for the type of ground processing required.

### 6.2.1 Subsystem/Element Letter Code

The subsystem/element letter code (first character) follows the same convention as ST-ICD-26, Part 5. These subsystem letter codes are as follows:

A	STRUCTURE & MECH (S&M)
B	SOLAR ARRAY II
C	SSM EPS
D	SSM DMS
E	OTA
F	FGS/FGE
G	SSM PCS
H	SSM I&C
I	Deleted
J	(CURRENTLY USED BY ScI IN OSS)
K	COSTAR
L	Deleted
M	SI C&DH
N	NICMOS
O	STIS
P	PIT DATA
Q	PCS S/W
R	PCS SIMULATOR
S	SSM PSEA
T	SSM TC
U	WFPC II
V	HSP ( historical-no longer used in current PDB)
W	WFPC I ( historical-no longer used in current PDB)
X	FOC
Y	FOS
Z	HRS

## 6.2.2 Subsystem/Element Component Code

The Subsystem/Element Component code (second and third characters) is as follows:

### SSM

00	Blank or multiple units	37	PDU#4	76	RF	SW	1
01	MA Transponder #1	38	CCC #1	77	RF	SW	2
02	MA Transponder #2	39	CCC #2	78	Xfer	SW	1
03	SSA Transmitter #1	40	CCC #3	79	Xfer	SW	2
04	SSA Transmitter #2	41	CCC #4	80	Circ	SW	
05	GEA 1	42	CCC #5	82	ICU	A/B	
06	GEA 2	43	RGA 1-1	83	General I&C		
07	TRI	44	RGA 1-2	84	Battery		1
08	DIUI	45	RGA 2-3	85	Battery		2
09	CDI	46	RGA 2-4	86	Battery		3
10	DIU #2	47	RGA 3-5	87	Battery		4
11	DIU #3	48	RGA 3-6	88	Battery		5
12	DIU #4	49	FHST #1	89	Battery		6
13	DIU #5	50	FHST #2	90	CCC		6
14	DMU	51	FHST #3	91	CSS		1
15	ESTR #1	52	RWA #1	92	CSS		2
16	ESTR #2	53	RWA #2	93	CSS		3
17	ESTR #3	54	RWA #3	94	CSS		4
18	General DMS	55	RWA #4				
19	SSM Computer S/W	56	MSS #1				
20	OCXO-A	57	MSS #2				
21	OCXO-B	58	MTE 1A				
22	SSM Computer H/W	59	MTE 1B				
23	Applications Software	60	MTE 2A				
24	General Solar Array	61	MTE 2B				
25	SA ECA	62	MTE 3A				
26	+V2 Wing	63	MTE 3B				
27	-V2 Wing	64	MTE 4A				
28	SADE #1	65	MTE 4B				
29	SADE #2	66	PSEA				
30	SA DCE	67	RMGA				
31	MCU	68	General PCS				
32	General EPS	69	GSE/STE				
33	PCU	72	Aperture Door Mechanisms				
34	PDU #1	73	SA Mechanisms				
35	PDU #2	74	HGA Mechanisms				
36	PDU #3	75	SSM Structure				

OTA

00 OTA DIU  
01 FGS 1  
02 FGS 2  
03 FGS 3  
04 OCS  
05 EP/TCE  
06 ACS  
07 Multiple units

SI C&DH

01 NSSC-I H/W  
02 PCU  
03 RIU  
04 CU  
05 SDF  
06 STINT  
10 NSSC-I S/W (EXEC)  
11 NSSC-I S/W (FOC)  
12 NSSC-I S/W (FOS)  
13 NSSC-I S/W (HRS)  
14 NSSC-I S/W (HSP)  
15 NSSC-I S/(WFPC)  
16 NSSC-I S/W CMD  
17 Spares

HRS

00 SPARE  
01 DEB 1  
02 DEB 2  
03 MEB 1  
04 MEB 2  
05 LVPS 1  
06 LVPS 2  
07 Shutter Mechanism  
08 Vent Door 1  
09 Vent Door 2  
10 Aperture Door 1  
11 Aperture Door 2  
12 Not Used  
13 Carrousel Deb 1  
14 Carrousel Deb 2  
15 Not Used  
16 Applications S/W  
17 HVPS 1  
18 HVPS 2  
19 Carrousel Mechanism  
20 RIUA  
21 RIUB  
22 Detector Radiator  
23 Detector 1  
24 Detector 2  
25 Spec Cal Lamp 1  
26 Spec Cal Lamp 2  
27 Thermal Shelf  
28 Optical Bench  
29 Enclosure  
30 Thermal Controllers

FOS

01 MEC  
02 CEA  
03 CPS  
04 Signal Processor  
05 HVPS  
06 PSA  
07 PSB  
08 CLPS  
09 RIU A  
10 RIU B  
11 General FOS

FOC

01 Calibrationib. Source  
02 Camera EHT  
03 Camera Elex Unit  
04 Detector Head Unit  
05 Data I/F Control Unit  
06 Intensifier EHT  
07 MDE  
08 NSSC-I  
09 FOC OBC  
10 PCU-CM  
11 PCU-PDA  
12 SDS  
13 TCE  
14 VPU  
15 RIU  
16 NSSC-I/OBC

HSP

01 PCDS  
02 Systems Controller  
03 RIUA  
04 RIUB  
05 DCA 1  
06 DCA 2  
07 DCA 3  
08 DCA 4  
09 DCA 5  
10 DEA 1  
11 DEA 2  
12 DEA 3  
13 DEA 4  
14 DEA 5  
15 HSP Structure  
16 ODS

COSTAR

00-Spare  
01-RIU A  
02-RIU B  
03-Hold Power 1  
04-Hold Power 2  
05-Operate Converter 1, 2  
06-MEB 1, 2  
07-DOB  
08-FOC M1 Arm  
09-FOC M2 Arm  
10-FOS M2 Arm  
11-GHRS M2 Arm  
12-FOC Optical Mechanisms

WFPC I/WFPC II

01 Camera Elex  
02 Optical Bench  
03 SOFA  
04 WFPC Tec  
05 Optic Assy/Pyramid  
06 Shutter Assembly  
07 WFPC Micro-P  
08 Power Convertor  
09 6.144 MHZ Clock  
10 RIU/RM  
11 WFPC General  
12 Structure/Bays

13-FOS Optical Mechanisms  
14-GHRS Optical Mechanisms  
15-Lower Thermal Shelf  
16-Upper Thermal Shelf  
17-LVDTs  
18-DITS  
19-Enclosure  
20-Fixed Bench  
21-A Fitting  
22-B Fitting  
23-C Fitting  
24-Thermal Controllers

### 6.2.3 Parameter Letter Code

The parameter letter code (fourth character) is the following:

A	Acceleration	L	Velocity
B	Magnetic Field	P	Pressure
C	Current	Q	Counters
E	Power	R	Rate
F	Frequency	S	Star Magnitude
G	Force, Stress, Strain	T	Temperature
H	Position	V	Voltage, Resistance
J	Computer Address, Error, Bias, Quantity, Pointer	W	Time
K	Command	X	Bi-level and multi-level events
		Z	Spare

### 6.2.4 Measurement Sequential Number

The Measurement Sequential Number (fifth, sixth, and seventh characters) uniquely identifies each measurement within the subsystem or major element.

### 6.2.5 Ground Processing Letter Code

The ground letter code (eighth character) is the following:

1. A for analog type ground station processing where there is a calibration curve, or continuous function, between input and output. Or simply the data (Pulse Code Modulation [PCM] Counts) is converted to decimal, octal, or hexadecimal.
2. B for bi-levels which are always single bits. Each individual bi-level has a measurement number. Each of the two bi-level states has an equivalent English statement (8 characters maximum) for console display.
3. D for multi-level data having a maximum of up to 32 discrete output states. Each state has an equivalent English statement (8 characters maximum) for console display.

## 6.3 MEASUREMENT NAME

The measurement name provides a descriptive title (20 characters maximum) for each measurement. All characters are legal.

## 6.4 FORMAT FIELD

(Columns 34:35) The Format Field which consists of two alphanumeric characters (the second character may be a blank) is the format identifier for the record. All "ZI" records following a particular configuration set must have the same format identifier in the first characters as that on the "CM" record of the configuration set. The second character of the field (if not blank) must be either "F" or "N". "F" indicates a SI or C&DH monitor on the fixed SI C&DH subformat: "N" indicates a SI or C&DH monitor on the normal SI C&DH subformat. If the second character of the field is blank, it indicates a SSM monitor.

Examples:

1. T for SSM monitors.
2. TF for SI fixed monitors.
3. TN for SI normal monitors.

Current legal values are T, TF, TN, A, AF, AN, F, FF, FN, P, PF, PN, X, XF, XN, Y, YF, YN, Z, ZF, ZN, C, CF, D, DF, E, EF, S, M, and U. More formats may be defined as the Project dictates.

## 6.5 DOWNLINK FORMAT DATA POSITION

As used in this context, the phrase Downlink Data Format Position, Telemetry Location and Telemetry Channel are used interchangeably and have the same meaning. There are places in this document where the phrase telemetry location has been used instead of downlink format data position, but that is unintentional and does not carry any significance. The notation used in this column defines the bitstream location of measurements in the TM format as explained by the following examples. Numbers are decimal values.

The maximum size for this field is fifteen characters. If this is not enough to fully describe the TM Channel location for a specific monitor, a Continuation Record ZI is used to complete the description. To indicate that the TM Channel Field is continued on the next record, and underscore (\_) character is used as the last nonblank character in this field. There are many forms for expressing the location of the monitor in the format. A few examples are listed below.

A number of characters are legal in this field and they each have particular meaning. The characters that are legal are "/" (slash), "," (comma), ":" (colon), "-" (dash), "\*" (asterisk), "+" (plus sign) and "[x]" (square brackets).

The slash indicates a subframe word location. The minor frame word appears before the slash. The minor frame number or subframe location (these phrases are used interchangeably) appears after the slash. The minor frame number that appears should not be greater than the subframe depth specified on the ZS record in the TCON % file for the minor frame word specified for that format. For example, in format A the ZS record may look like this: "CS AN 41 1 8 ...ZS ". The telemetry location of a monitor on word 41 cannot be 41/10 as 10 is greater than the allowed subframe depth of 8 in the ZS record.

The comma indicates more than one telemetry location either on the minor frame (XX,YY) or in the major frame (XX/ZZ,YY/ZZ). This results in a higher sample rate than would occur if the monitor were sampled only once in the minor frame or once in the major frame, as appropriate. Generally, this technique is only used for monitors that are desired to appear more than once per minor frame or to assign many spare locations to a single monitor.

The colon indicates that a bit specification or bit range follows.

The dash indicates a range of words or range of bits. If the range is a bit range, the dash is only used for bits within one word. If an integer number of telemetry words is specified using the dash to specify the word range, a bit specification is not necessary. An example of this is: 175/9:1-8 need only be specified as 175/9.

The asterisk indicates a bit range for a monitor that spans across telemetry word boundaries. This specification is used only if at least one of the telemetry words does not have all 8 bits specified. Examples of legal use include: 172-173/6:4\*8, 172-173/6:1\*4, 172-173/6:2\*7, and 172-173/6:7\*2. An illegal use is 172-173/6:1\*8.

The plus sign indicates that this monitor is a segmented monitor; part of it comes down in one telemetry location (the part before the plus sign), the rest of it comes down in another location (the part after the plus sign).

The brackets are used in two different situations. The first situation is for auto-assigned SSM hardware monitors. In this case, the brackets indicate to the SATS software that this is an auto-assigned measurement and the number within the brackets is the number of bits of the measurement. These characters should be the only characters in the telemetry location field in this usage. The second situation is for measurements that appear more than once in the subframe in which it is assigned. Instead of specifying all the locations that the monitor is assigned to, the brackets contain a number which indicates the repeat interval (number of minor frames) of the monitor. This technique is used for some SSM monitors, but mostly for SI and C&DH monitors in the normal formats.

NOTE: In this document, counting starts with one for minor frames, minor frame words, subframe words, and bits; and the count is from 1 to n. For example, the eight bits in a word are numbered 1 to 8 (from left to right).

1. 173 - Minor frame word 173. (This is an 8-bit measurement in word 173 of every minor frame.)
2. 174/9 - Minor frame word 174, subframe word 9. (This is an 8-bit measurement that is in the 9th word of the subframe. The subframe is in minor frame word 174.)
3. 174/10:5 - Minor frame word 174, subframe word 10, the 5th bit. (This is a single-bit, bi-level measurement that is in the 10th word of the subframe.)
4. 174/11:5-8 - Minor frame word 174, subframe word 11, bits 5 through 8. (This is a 4-bit measurement that is in the 11th word of the subframe.)
5. 174-175/12 - Minor frame words 174 and 175, subframe word 12. (This is a 16-bit measurement in the 12th word of a 16-bit subframe. The subframe is in minor frame words 174 and 175.)
6. 174-175/12:4\*3 - Minor frame words 174 and 175, subframe word 12, bits 4 to 8 of word 174, bits 1 to 3 of word 175. (This is an 8-bit measurement across a word boundary. The star indicates the start and end bits of the measurement. Words 174 and 175 are again as defined in example 5 above.)

7. 24/2+32/2 - Minor frame words 24 and 32, subframe word 2. (This is a 16-bit measurement occupying non-adjacent words within the same minor frame. The '+' also indicates that the data is requested in two 8-bit segments, a point important to ground processing.)
8. 174/12+175/12 - Minor frame words 174 and 175, subframe word 12. (This would appear to be the same as Example 5 above and, indeed, the bits are the same. However, like Example 7, this monitor is sampled in two 8-bit segments, and is therefore different than the 16-bit monitor in Example 5.)
9. 120/29+120/30 - Minor frame word 120, subframe words 29 and 30. (This is a 16-bit measurement occupying the same word in successive minor frames.)
10. 102/34:8[60] - Minor frame word 102, subframe word 34, bit 8. (This is a 1-bit measurement that is repeated in every 60 minor frame after the first (listed) Location. This technique is also known as subframe super commutation.)
11. 75,175 - Minor frame words 75 and 175. (This is a super commutated 8-bit measurement in word 75 and repeated in word 175 of every minor frame.)

#### 6.5.1 Most Significant Bit First

The Most Significant Bit (MSB) of a monitor is received first and is given first in the TM format. For example, if an 8-bit analog word is in bits 81 through 88, bit 81 will be MSB, and bit 88 will be Least Significant Bit (LSB). This convention applies to discrete event monitors also. In fixed formats D and E, the Data Management Unit (DMU) registers and the D/E minor and major frame counters (D14Q633A and D14Q634A) are exceptions as these appear LSB first.

#### 6.5.2 Auto Assigned Measurements

Measurements which take advantage of the auto assign capability of the ground database processing software fall into only one category; they can only be SSM hardware monitors. In addition, some other rules apply to auto-assigned monitors. These monitors create a demand for space in the telemetry format and, therefore, for memory space in the DF-224 when the format is loaded into the SSM DF-224 for use. If a particular sample rate is desired, it creates a demand for a certain depth subframe. If a subframe of that depth is already called for and not yet filled, the new monitor only fills a space that was taken up anyway by a "skip" in the subframe array table in the DF-224. In other words, no additional space was used. This is not always the case. If the new monitor was the 121st monitor to request a particular sample rate, the software will create a new subframe with a depth of 120, place the new monitor in the subframe, and follow it with 119 "skips", creating an additional 120 words of memory use in the DF-224. Obviously, this technique cannot be used without first inspecting the existing use of automatically created subframes and managing this use wisely to obtain a good compromise of sample rate for monitors and memory use of the DF-224. It will require coordination between the HST data base manager, Flight Software manager (DF-224 memory space), and subsystem personnel whose monitors may need to have the sample rates modified.

#### 6.6 SAMPLES PER SECOND

The sample rate of each measurement is determined by two factors: the data rate (4 kbps, 500 bps, etc.) of the format, and the depth of the subframe it is assigned to. A summary of sample rates is given for each format in its section. This number is a real number; i.e., 4.00, .017, etc.

#### 6.7 MEASUREMENT RANGE

The functional range of the measurement is given in engineering units of volts, degrees, etc. It is a value which should reflect the calibration for the measurement, but the calibration records are the source for the actual calibration data. All temperature ranges are in degrees Celsius. In the case of bi-level monitors the equivalent 8-character English statement for both bi-level states is given. The binary "1" state is given first. This should match the calibration record but is given here for information only. For discrete event monitors, the number of legal states is given. The field may be blank; but whatever is here, it must be identical in every format that the monitor appears in.

## 6.8 MEASUREMENT ACCURACY

The end-to-end measurement accuracy is a tolerance given in the same engineering units as the measurement range. This tolerance provides a figure of merit for the measurement. The measurement accuracy for digital words is the engineering unit value of the LSB. The measurement accuracy for the analog measurements is a rounded sum of the transducer design or calibrated accuracy, plus the design or calibrated accuracy of the analog-to-digital conversion process. The entire digital portion of the ST (spacecraft, Tracking and Data Relay Satellite System [TDRSS], NASA Communications Network [NASCOM] and Space Telescope Operations Control Center [STOCC]) is assumed to contribute zero error to the measurement accuracy. May be blank but whatever is here, it must be identical in every format that the monitor appears in.

## 6.9 SIGNAL TYPE

The information in this byte defines the signal type source that the NSSC-I expects. Legal characters are "A" for active analog, "B" for bi-level, "C" for conditioned (passive) analog, "N" for NSSC-I, "S" for serial digital, and blank for data points not accessed by the NSSC-I.

## 6.10 COMPONENT

The information given here depends on what type of monitor is being listed. For hardware monitors, this column lists the appropriate assembly or box that the measurement is monitoring, unless obvious from the measurement description. For some SSM temperature monitors, the seven-character transducer part number is shown. For most software monitors, the name of the software module where the variable is generated is given. For DMU status registers and command/data handling status words, the appropriate TLM word number is given as per SWA 1000A. May be blank; but whatever is here, it must be identical in every format that the monitor appears in.

Since the measurement range, measurement accuracy, and component may be blank, and since there is no provision in the instrumentation files for commenting, these fields together may be used for commenting. But, again, whatever is there must be identical in each record for a given Cross Reference Measurement ID.

## 6.11 MEASUREMENT ID

The Measurement ID is also known as the 'Friendly' mnemonic. The measurement ID is the ID that is used in flight operations of the ST. It consists of up to eight characters, the first being the subsystem letter code, and the remaining may be a shortened form of the measurement description. The only subsystem not currently using this form of mnemonic is SIC&DH. For SSM software analog monitors, this ID is typically the software symbol plus a number for an array (a vector measurement). For SSM software bi-level and multi-level event monitors, this ID is composed as described above, if possible. In cases where there are a number of bi-level monitors made up from a software word, each may have a measurement ID which is a compression or variation of the measurement name. Each measurement ID must be unique. It may not be blank; but whatever is here, it must be identical in every format that the monitor appears in and it must be unique.

## 6.12 DATA ADDRESS

The information given here depends on what type of monitor is listed. If the monitor is a SSM software monitor, field 2 of the cross-reference measurement number will be a '19', and the information shown will be the byte and bit definition, and the software variable name.

Immediately following the software variable name, there may or may not be a dollar sign and a hex number of 1 to F. If so, the dollar sign indicates that the monitor in that format is in a subcom group which is compressed in that format and the hex number indicates the subcom group number. What is meant by compressed is that the collection of monitors belonging to that subcom group are accessed by only the address of the first monitor in the group; the rest follow in sequence on each subsequent minor frame. The technique is used to reduce memory use in the DF-224 by the subframe array table for that format. For further information, see SSM Flight Software document DM-04 Volume III, LMSC/4173944 Appendix I, pages IO-1 to IO-5.

If the byte definition is just '0', it means that all 24 bits of the memory address are used. Otherwise, the eight-bit bytes of the address are labeled 1-3 from MSB to LSB, and the bits within each byte are labeled 1-8, MSB to LSB. If the monitor is a SSM or OTA hardware monitor, the information shown is the DIU number and channel (in octal), submux channel, if needed (in decimal starting at '0'), and bit pattern, if needed. If the monitor is a SI monitor, the information in this field is the DIU number and channel assigned to all SI TLM (5362), the Remote Interface Unit (RIU) number ('R' and then two numbers in octal), and the RIU line number ('L' and then two numbers in decimal) if available. One more number may appear after the RIU line number for Faint Object Spectrograph (FOS) and High Speed Photometer (HSP) monitors. This 1-digit number indicates whether the signal originates from a 'regular' RIU or from an RIU extension box. A '0' indicates regular RIU, and a '1' stands for extension box. For measurements that are SSM HW or payload measurements, this information must be identical for every format the monitor appears in.

The address for a software monitor is obtained from an indexed sequential symbols table file using the symbol name as the record key. An address bias can be specified for a software monitor by inserting a plus ('+') sign after the symbol name which is followed by the offset in decimal words. There can be no blanks between the symbol name and the offset; the offset is considered part of the symbol parameter for the field.

Monitors such as sync and format ID that have no entry in the symbols table file must be enclosed in parentheses to identify this class of monitor. The bits definition parameter is not required for these monitors, and is currently ignored if present. The multiplexing of S/W monitors is specified by adding a dollar sign and hex number to the address field. This will make monitors of the same subcom group to be taken from the same address.

#### Examples:

2100	Hardware Monitor, DIU 2, Channel 100
3363:4	Hardware Monitor, DIU 3, Channel 363, Bit 4
5363: 4-7	Hardware Monitor, DIU 5, Channel 363, Bits 4-7
1220.12	Hardware Monitor, DIU 1, Channel 220, Submux Word 12
O DVEXT	Software Monitor, All 3 Bytes (24 Bits). Symbol name DVEXT
DDSUM1 1	Software Monitor, Byte 1 (All 8 Bits). Symbol name DDSUM1
DTTTEQ 2,3	Software Monitor, Bytes 2 and 3 (16 total Bits). Symbol name DTTTEQ
1:3-5 RWASS	Software Monitor, Byte 1, Bits 3 thru 5. Symbol name RWASS
C1VAC+3 2,3	Software Monitor, Bytes 2 and 3 (16 total Bits) Symbol name C1VAC, address of C1VAC + 3
SPQR	Software Monitor, all 3 Bytes (24 Bits). Symbol name SPQR
(SYNC)	Software Monitor, Symbol not in the symbol tables file.
DSDSA\$8	Software Monitor, Subcom Group 8

### 6.13 APERTURE

The aperture is a value which was used at Lockheed Missiles and Space Company (Sunnyvale) to compress data handling loads during test. The aperture is a decimal counts value which represents the minimum significant change for a monitor. In other words, a monitor must change its reading at least by this amount to be considered important enough to update. The value of the aperture could be altered during a test, but the value shown here is what it was set to initially. Since this is not used for flight operations, a value of 1 should appear here. For bi-level and multi-level event monitors, a value of 1 must appear, if unsure of a value, use 1. Additionally, for analog monitors whose data is in two's complement format, an S may appear in character position 129 to so indicate. In any case, the value of the aperture may not be less than 0 nor greater than 255.

